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(71) Applicant: **Matsushita Electric Industrial Co., Ltd.**
Kadoma-shi, Osaka-fu 571-8501 (JP)

(72) Inventors:
- **Okada, Tomoyuki**
Katano-shi, Osaka 576 (JP)
- **Mori, Yoshihiro**
Hirakata-shi, Osaka 573 (JP)
- **Tsuga, Kazuhiro**
Takarazuka-shi, Hyogo 665 (JP)
- **Hamasaka, Hiroshi**
Hirakata-shi, Osaka 573 (JP)
- **Ishihara, Hideshi**
Katano-shi, Osaka 576 (JP)
- **Nakamura, Kazuhiko**
Hirakata-shi, Osaka 573 (JP)
- **Hasebe, Takumi**
Yawata-shi, Kyoto 614 (JP)

(74) Representative: **Eisenführ, Speiser & Partner**
Martinistrasse 24
28195 Bremen (DE)

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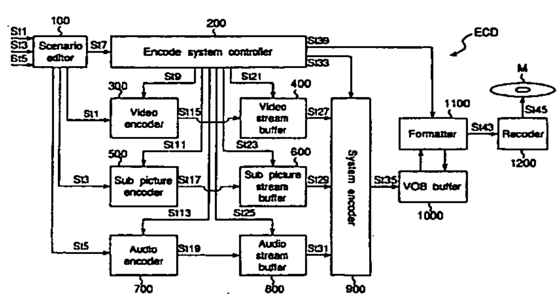
(54) **Method and apparatus for encoding bitstreams for seamless reproduction**

(57) An optical disk having such a data structure that moving image data and audio data are naturally reproduced under one title without stoppage (freeze), etc., of video display at the connections of system streams (VOB) in which the data are interleaved when the data are reproduced by connecting the system streams (VOB) to each other. At least the first audio frame (Af) contains the same audio data in a plurality of branched stream systems (VOB) and at least the last GOP contains the same moving picture in a plurality of system streams (VOB) before connected.

Fig.25



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efficiently utilize optical disk capacity, multi-scene control whereby scene data common to plural titles and the desired scenes on the same time-base from within multi-scene periods containing plural scenes unique to particular reproduction paths can be freely selected and reproduced is desirable.

[0014] However, when plural scenes unique to a reproduction path within the multi-scene period are arranged on the same time-base, the scene data must be contiguous. Unselected multi-scene data is therefore unavoidably inserted between the selected common scene data and the selected multi-scene data. The problem this creates when reproducing multi-scene data is that reproduction is interrupted by this unselected scene data.

[0015] When one of the multiple scenes is connected to common scene data, the difference between the video reproduction time and the audio reproduction time differs on each of the reproduction paths because of the offset between the audio and video frame reproduction times. As a result, the audio or video buffer underflows at the scene connection, causing video reproduction to stop ("freeze") or audio reproduction to stop ("mute"), and thus preventing seamless reproduction. It will also be obvious that the difference between the audio and video reproduction times can cause a buffer underflow state even when common scene data is connected 1:1.

[0016] Therefore, the object of the present invention is to provide a data structure whereby multi-scene data can be naturally reproduced as a single title without the video presentation stopping ("freezing") at one-to-one, one-to-many, or many-to-many scene connections in the system stream; a method for generating a system stream having said data structure; a recording apparatus and a reproduction apparatus for recording and reproducing said system stream; and a medium to which said system stream can be recorded and from which said system stream can be reproduced by said recording apparatus and reproduction apparatus.

[0017] The present application is based upon Japanese Patent Application No. 7-252735 and 8-041581, which were filed on September 29, 1995 and February 28, 1996, respectively, the entire contents of which are expressly incorporated by reference herein.

Disclosure of Invention

[0018] The present invention has been developed with a view to substantially solving the above described disadvantages and has for its essential object to provide an optical disk for recording more than one system stream containing audio data and video data, wherein the audio data and video data of the plural system streams recorded to the optical disk are interleaved such that the difference between the input start times of the video data and audio data to the video buffer in the video decoder and the audio buffer in the audio decoder is less than the reproduction time of the number of audio frames that can be stored in the audio buffer plus one audio frame.

Brief Description of Drawings

[0019]

Fig. 1 is a graph schematically showing a structure of multi media bit stream according to the present invention,

Fig. 2 is a block diagram showing an authoring encoder according to the present invention,

Fig. 3 is a block diagram showing an authoring decoder according to the present invention,

Fig. 4 is a side view of an optical disk storing the multi media bit stream of Fig. 1,

Fig. 5 is an enlarged view showing a portion confined by a circle of Fig. 4,

Fig. 6 is an enlarged view showing a portion confined by a circle of Fig. 5,

Fig. 7 is a side view showing a variation of the optical disk of Fig. 4,

Fig. 8 is a side view showing another variation of the optical disk of Fig. 4,

Fig. 9 is a plan view showing one example of track path formed on the recording surface of the optical disk of Fig. 4,

Fig. 10 is a plan view showing another example of track path formed on the recording surface of the optical disk of Fig. 4,

Fig. 11 is a diagonal view schematically showing one example of a track path pattern formed on the optical disk of Fig. 7,

Fig. 12 is a plan view showing another example of track path formed on the recording surface of the optical disk of Fig. 7,

Fig. 13 is a diagonal view schematically showing one example of a track path pattern formed on the optical disk of Fig. 8,

Fig. 14 is a plan view showing another example of track path formed on the recording surface of the optical disk of Fig. 8,

Fig. 15 is a flow chart showing details of the decoder synchronization process of Fig. 66,

Fig. 16 is a graph schematically showing the structure of multimedia bit stream for use in Digital Video Disk system according to the present invention,

Fig. 17 is a graph schematically showing the encoded video stream according to the present invention,

Fig. 18 is a graph schematically showing an internal structure of a video zone of Fig. 16.

Fig. 19 is a graph schematically showing the stream management information according to the present invention,

Fig. 20 is a graph schematically showing the structure the navigation pack NV of Fig. 17,

Fig. 21 is a graph in assistance of explaining a concept of parental lock playback control according to

the present invention,
Fig. 22 is a graph schematically showing the data structure used in a digital video disk system according to the present invention,
Fig. 23 is a graph in assistance of explaining a concept of Multi-angle scene control according to the present invention,
Fig. 24 is a graph in assistance of explaining a concept of multi scene data connection,
Fig. 25 is a block diagram showing a DVD encoder according to the present invention,
Fig. 26 is a block diagram showing a DVD decoder according to the present invention,
Fig. 27 is a graph schematically showing an encoding information table generated by the encoding system controller of Fig. 25,
Fig. 28 is a graph schematically showing an encoding information tables,
Fig. 29 is a graph schematically showing an encoding parameters used by the video encoder of Fig. 25,
Fig. 30 is a graph schematically showing an example of the contents of the program chain information according to the present invention,
Fig. 31 is a graph schematically showing another example of the contents of the program chain information according to the present invention,
Fig. 32 is a flow chart showing the encode parameters generating operation for a system stream containing a single scene,
Fig. 33 is a graph in assistance of explaining a concept of multi-angle scene control according to the present in invention,
Fig. 34 is a flow chart, formed by Figs. 34A and 34B, showing an operation of the DVD encoder of Fig. 25,
Fig. 35 is a flow chart showing detailed of the encode parameter production sub-routine of Fig. 34,
Fig. 36 is a flow chart showing the detailed of the VOB data setting routine of Fig. 35,
Fig. 37 is a flow chart showing the encode parameters generating operation for a seamless switching,
Fig. 38 is a flow chart showing the encode parameters generating operation for a system stream,
Fig. 39 is a graph showing simulated results of data input/output to the video buffer and audio buffer of the DVD decoder of Fig. 26,
Fig. 40 is a graph in assistance of explaining a concept of parental control according to the present invention,
Fig. 41 is a graph in assistance of explaining the data input/output to the video buffer of the DVD decoder DCD shown in Fig. 26 during contiguous reproduction,
Fig. 42 is a graph in assistance of explaining a possible problem under a parental lock control example shown in Fig. 40,
Fig. 43 is a graph in assistance of explaining a reproduction gap generated under parental lock control,
Fig. 44 is a graph showing a system streams produced according to the present invention,
Fig. 45 is a graph in assistance of explaining an operation whereby these system streams are connected,
Fig. 46 is a graph in assistance of explaining a method of generating a system streams,
Fig. 47 is a graph in assistance of explaining another method of producing a system stream,
Fig. 48 is a graph showing a structure of the end of the second common system stream and the beginnings of the two parental lock control system streams,
Fig. 49 is a graph in assistance of explaing the difference in the video reproduction time and audio reproduction time of different reproduction paths,
Fig. 50 is a block diagram showing an internal structure of the system encoder in the DVD encoder of Fig. 25,
Fig. 51 is a graph showing a structure of the end of the two parental lock control system streams and the beginning of the following common system stream Sse,
Fig. 52 is a graph in assistance of explaining the difference in the video reproduction time and audio reproduction time of different reproduction paths,
Fig. 53 is a flow chart showing details of system stream producing routine of Fig. 34,
Fig. 54 is a graph in assistance of explaining an operation to calculate an audio data movement MFAp1,
Fig. 55 is a graph in assistance of explaining an operation to calculate an audio data movement MFAp2,
Fig. 56 is a block diagram showing an internal structure of the synchronizer of Fig. 26,
Fig. 57 is a flow chart showing an operation executed by the audio decoder controller of Fig. 26,
Figs. 58 and 59 are graphs showing decoding information table produced by the decoding system controller of Fig. 26,
Fig. 60 is a flow chart showing the operation of the DVD decoder DCD of Fig. 26,
Fig. 61 is a flow chart showing details of reproduction extracted PGC routing of Fig. 60,
Fig. 62 is a flow chat showing details of the stream buffer data transfer process according to the present invention,
Fig. 63 is a flow chart showing details of the non multi-angle decoding process of Fig. 62,
Fig. 64 is a flow chart showing details of the non-multi-angled interleave process of Fig. 63,
Fig. 65 is a flow chart showing details of the non-multi-angled contiguous block process,
Fig. 66 is a flow chart showing details of decoding

data process of Fig. 64, performed by the stream buffer, is shown,

Fig. 67 is a graph schematically showing an actual arrangement of data blocks recorded to a data recording track on a recording medium according to the present invention,

Fig. 68 is a graph schematically showing contiguous block regions and interleaved block regions array,

Fig. 69 is a graph schematically showing a content of a VTS title VOBS according to the present invention, and

Fig. 70 is a graph schematically showing an internal data structure of the interleaved block regions according to the present invention.

Best Mode for Carrying Out the Invention

[0020] The prevent invention is detailedly described with reference to the accompanying drawings.

Data structure of the authoring system

[0021] The logic structure of the multimedia data bitstream processed using the recording apparatus, recording medium, reproduction apparatus, and authoring system according to the present invention is described first below with reference to Fig. 1.

[0022] In this structure, one title refers to the combination of video and audio data expressing program content recognized by a user for education, entertainment, or other purpose. Referenced to a motion picture (movie), one title may correspond to the content of an entire movie, or to just one scene within said movie.

[0023] A video title set (VTS) comprises the bitstream data containing the information for a specific number of titles. More specifically, each VTS comprises the video, audio, and other reproduction data representing the content of each title in the set, and control data for controlling the content data.

[0024] The video zone VZ is the video data unit processed by the authoring system, and comprises a specific number of video title sets. More specifically, each video zone is a linear sequence of K + 1 video title sets numbered VTS #0 - VTS #K where K is an integer value of zero or greater. One video title set, preferably the first video title set VTS #0, is used as the video manager describing the content information of the titles contained in each video title set.

[0025] The multimedia bitstream MBS is the largest control unit of the multimedia data bitstream handled by the authoring system of the present invention, and comprises plural video zones vz.

Authoring encoder EC

[0026] A preferred embodiment of the authoring encoder EC according to the present invention for generating a new multimedia bitstream MBS by re-encoding the original multimedia bitstream MBS according to the scenario desired by the user is shown in Fig. 2. Note that the original multimedia bitstream MBS comprises a video stream St1 containing the video information, a sub-picture stream St3 containing caption text and other auxiliary video information, and the audio stream St5 containing the audio information.

[0027] The video and audio streams are the bitstreams containing the video and audio information obtained from the source within a particular period of time. The sub-picture stream is a bitstream containing momentary video information relevant to a particular scene. The sub-picture data encoded to a single scene may be captured to video memory and displayed continuously from the video memory for plural scenes as may be necessary.

[0028] When this multimedia source data St1, St3, and St5 is obtained from a live broadcast, the video and audio signals are supplied in real-time from a video camera or other imaging source; when the multimedia source data is reproduced from a video tape or other recording medium, the audio and video signals are not real-time signals.

[0029] While the multimedia source stream is shown in Fig. 2 as comprising these three source signals, this is for convenience only, and it should be noted that the multimedia source stream may contain more than three types of source signals, and may contain source data for different titles. Multimedia source data with audio, video, and sub-picture data for plural titles are referred to below as multi-title streams.

[0030] As shown in Fig. 2, the authoring encoder EC comprises a scenario editor 100, encoding system controller 200, video encoder 300, video stream buffer 400, sub-picture encoder 500, sub-picture stream buffer 600, audio encoder 700, audio stream buffer 800, system encoder 900, video zone formatter 1300, recorder 1200, and recording medium M.

[0031] The video zone formatter 1300 comprises video object (VOB) buffer 1000, formatter 1100, and volume and file structure formatter 1400.

[0032] The bitstream encoded by the authoring encoder EC of the present embodiment is recorded by way of example only to an optical disk.

[0033] The scenario editor 100 of the authoring encoder EC outputs the scenario data, i.e., the user-defined editing instructions. The scenario data controls editing the corresponding parts of the multimedia bitstream MBS according to the user's manipulation of the video, sub-picture, and audio components of the original multimedia title. This scenario editor 100 preferably comprises a display, speaker(s), keyboard, CPU, and source stream buffer. The scenario editor 100 is connected to an external multimedia bitstream source from which the multimedia source data St1, St3, and St5 are supplied.

[0034] The user is thus able to reproduce the video

and audio components of the multimedia source data using the display and speaker to confirm the content of the generated title. The user is then able to edit the title content according to the desired scenario using the keyboard, mouse, and other command input devices while confirming the content of the title on the display and speakers. The result of this multimedia data manipulation is the scenario data St7.

[0035] The scenario data St7 is basically a set of instructions describing what source data is selected from all or a subset of the source data containing plural titles within a defined time period, and how the selected source data is reassembled to reproduce the scenario (sequence) intended by the user. Based on the instructions received through the keyboard or other control device, the CPU codes the position, length, and the relative time-based positions of the edited parts of the respective multimedia source data streams St1, St3, and St5 to generate the scenario data St7.

[0036] The source stream buffer has a specific capacity, and is used to delay the multimedia source data streams St1, St3, and St5 a known time Td and then output streams St1, St3, and St5.

[0037] This delay is required for synchronization with the editor encoding process. More specifically, when data encoding and user generation of scenario data St7 are executed simultaneously, i.e., when encoding immediately follows editing, time Td is required to determine the content of the multimedia source data editing process based on the scenario data St7 as will be described further below. As a result, the multimedia source data must be delayed by time Td to synchronize the editing process during the actual encoding operation. Because this delay time Td is limited to the time required to synchronize the operation of the various system components in the case of sequential editing as described above, the source stream buffer is normally achieved by means of a high speed storage medium such as semiconductor memory.

[0038] During batch editing in which all multimedia source data is encoded at once ("batch encoded") after scenario data St7 is generated for the complete title, delay time Td must be long enough to process the complete title or longer. In this case, the source stream buffer may be a low speed, high capacity storage medium such as video tape, magnetic disk, or optical disk.

[0039] The structure (type) of media used for the source stream buffer may therefore be determined according to the delay time Td required and the allowable manufacturing cost.

[0040] The encoding system controller 200 is connected to the scenario editor 100 and receives the scenario data St7 therefrom. Based on the time-base position and length information of the edit segment contained in the scenario data St7, the encoding system controller 200 generates the encoding parameter signals St9, St11, and St13 for encoding the edit segment of the multimedia source data. The encoding signals St9, St11, and St13 supply the parameters used for video, sub-picture, and audio encoding, including the encoding start and end timing. Note that multimedia source data St1, St3, and St5 are output after delay time Td by the source stream buffer, and are therefore synchronized to encoding parameter signals St9, St11, and St13.

[0041] More specifically, encoding parameter signal St9 is the video encoding signal specifying the encoding timing of video stream St1 to extract the encoding segment from the video stream St1 and generate the video encoding unit. Encoding parameter signal St11 is likewise the sub-picture stream encoding signal used to generate the sub-picture encoding unit by specifying the encoding timing for sub-picture stream St3. Encoding parameter signal St13 is the audio encoding signal used to generate the audio encoding unit by specifying the encoding timing for audio stream St5.

[0042] Based on the time-base relationship between the encoding segments of streams St1, St3, and St5 in the multimedia source data contained in scenario data St7, the encoding system controller 200 generates the timing signals St21, St23, and St25 arranging the encoded multimedia-encoded stream in the specified time-base relationship.

[0043] The encoding system controller 200 also generates the reproduction time information IT defining the reproduction time of the title editing unit (video object, VOB), and the stream encoding data St33 defining the system encode parameters for multiplexing the encoded multimedia stream containing video, audio, and sub-picture data. Note that the reproduction time information IT and stream encoding data St33 are generated for the video object VOB of each title in one video zone VZ.

[0044] The encoding system controller 200 also generates the title sequence control signal St39, which declares the formatting parameters for formatting the title editing units VOB of each of the streams in a particular time-base relationship as a multimedia bitstream. More specifically, the title sequence control signal St39 is used to control the connections between the title editing units (VOB) of each title in the multimedia bitstream MBS, or to control the sequence of the interleaved title editing unit (VOBs) interleaving the title editing units VOB of plural reproduction paths.

[0045] The video encoder 300 is connected to the source stream buffer of the scenario editor 100 and to the encoding system controller 200, and receives therefrom the video stream St1 and video encoding parameter signal St9, respectively. Encoding parameters supplied by the video encoding signal St9 include the encoding start and end timing, bit rate, the encoding conditions for the encoding start and end, and the material type. Possible material types include NTSC or PAL video signal, and telecine converted material. Based on the video encoding parameter signal St9, the video encoder 300 encodes a specific part of the video stream St1 to generate the encoded video stream St15.

data process of Fig. 64, performed by the stream buffer, is shown,

Fig. 67 is a graph schematically showing an actual arrangement of data blocks recorded to a data recording track on a recording medium according to the present invention,

Fig. 68 is a graph schematically showing contiguous block regions and interleaved block regions array,

Fig. 69 is a graph schematically showing a content of a VTS title VOBS according to the present invention, and

Fig. 70 is a graph schematically showing an internal data structure of the interleaved block regions according to the present invention.

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[0024] The video zone VZ is the video data unit processed by the authoring system, and comprises a specific number of video title sets. More specifically, each video zone is a linear sequence of K + 1 video title sets numbered VTS #0 - VTS #K where K is an integer value of zero or greater. One video title set, preferably the first video title set VTS #0, is used as the video manager describing the content information of the titles contained in each video title set.

[0025] The multimedia bitstream MBS is the largest control unit of the multimedia data bitstream handled by the authoring system of the present invention, and comprises plural video zones vz.

Authoring encoder EC

[0026] A preferred embodiment of the authoring encoder EC according to the present invention for generating a new multimedia bitstream MBS by re-encoding the original multimedia bitstream MBS according to the scenario desired by the user is shown in Fig. 2. Note that the original multimedia bitstream MBS comprises a video stream St1 containing the video information, a sub-picture stream St3 containing caption text and other auxiliary video information, and the audio stream St5 containing the audio information.

[0027] The video and audio streams are the bitstreams containing the video and audio information obtained from the source within a particular period of time. The sub-picture stream is a bitstream containing momentary video information relevant to a particular scene. The sub-picture data encoded to a single scene may be captured to video memory and displayed continuously from the video memory for plural scenes as may be necessary.

[0028] When this multimedia source data St1, St3, and St5 is obtained from a live broadcast, the video and audio signals are supplied in real-time from a video camera or other imaging source; when the multimedia source data is reproduced from a video tape or other recording medium, the audio and video signals are not real-time signals.

[0029] While the multimedia source stream is shown in Fig. 2 as comprising these three source signals, this is for convenience only, and it should be noted that the multimedia source stream may contain more than three types of source signals, and may contain source data for different titles. Multimedia source data with audio, video, and sub-picture data for plural titles are referred to below as multi-title streams.

[0030] As shown in Fig. 2, the authoring encoder EC comprises a scenario editor 100, encoding system controller 200, video encoder 300, video stream buffer 400, sub-picture encoder 500, sub-picture stream buffer 600, audio encoder 700, audio stream buffer 800, system encoder 900, video zone formatter 1300, recorder 1200, and recording medium M.

[0031] The video zone formatter 1300 comprises video object (VOB) buffer 1000, formatter 1100, and volume and file structure formatter 1400.

[0032] The bitstream encoded by the authoring encoder EC of the present embodiment is recorded by way of example only to an optical disk.

[0033] The scenario editor 100 of the authoring encoder EC outputs the scenario data, i.e., the user-defined editing instructions. The scenario data controls editing the corresponding parts of the multimedia bitstream MBS according to the user's manipulation of the video, sub-picture, and audio components of the original multimedia title. This scenario editor 100 preferably comprises a display, speaker(s), keyboard, CPU, and source stream buffer. The scenario editor 100 is connected to an external multimedia bitstream source from which the multimedia source data St1, St3, and St5 are supplied.

[0034] The user is thus able to reproduce the video

[0046] The sub-picture encoder 500 is similarly connected to the source stream buffer of the scenario editor 100 and to the encoding system controller 200, and receives therefrom the sub-picture stream St3 and sub-picture encoding parameter signal St11, respectively. Based on the sub-picture encoding parameter signal St11, the sub-picture encoder 500 encodes a specific part of the sub-picture stream St3 to generate the encoded sub-picture stream St17.

[0047] The audio encoder 700 is also connected to the source stream buffer of the scenario editor 100 and to the encoding system controller 200, and receives therefrom the audio stream St5 and audio encoding parameter signal St13, which supplies the encoding start and end timing. Based on the audio encoding parameter signal St13, the audio encoder 700 encodes a specific part of the audio stream St5 to generate the encoded audio stream St19.

[0048] The video stream buffer 400 is connected to the video encoder 300 and to the encoding system controller 200. The video stream buffer 400 stores the encoded video stream St15 input from the video encoder 300, and outputs the stored encoded video stream St15 as the time-delayed encoded video stream St27 based on the timing signal St21 supplied from the encoding system controller 200.

[0049] The sub-picture stream buffer 600 is similarly connected to the sub-picture encoder 500 and to the encoding system controller 200. The sub-picture stream buffer 600 stores the encoded sub-picture stream St17 output from the sub-picture encoder 500, and then outputs the stored encoded sub-picture stream St17 as time-delayed encoded sub-picture stream St29 based on the timing signal St23 supplied from the encoding system controller 200.

[0050] The audio stream buffer 800 is similarly connected to the audio encoder 700 and to the encoding system controller 200. The audio stream buffer 800 stores the encoded audio stream St19 input from the audio encoder 700, and then outputs the encoded audio stream St19 as the time-delayed encoded audio stream St31 based on the timing signal St25 supplied from the encoding system controller 200.

[0051] The system encoder 900 is connected to the video stream buffer 400, sub-picture stream buffer 600, audio stream buffer 800, and the encoding system controller 200, and is respectively supplied thereby with the time-delayed encoded video stream St27, time-delayed encoded sub-picture stream St29, time-delayed encoded audio stream St31, and the stream encoding data St33. Note that the system encoder 900 is a multiplexer that multiplexes the time-delayed streams St27, St29, and St31 based on the stream encoding data St33 (timing signal) to generate title editing unit (VOB) St35. The stream encoding data St33 contains the system encoding parameters, including the encoding start and end timing.

[0052] The video zone formatter 1300 is connected to the system encoder 900 and the encoding system controller 200 from which the title editing unit (VOB) St35 and title sequence control signal St39 (timing signal) are respectively supplied. The title sequence control signal St39 contains the formatting start and end timing, and the formatting parameters used to generate (format) a multimedia bitstream MBS. The video zone formatter 1300 rearranges the title editing units (VOB) St35 in one video zone VZ in the scenario sequence defined by the user based on the title sequence control signal St39 to generate the edited multimedia stream data St43.

[0053] The multimedia bitstream MBS St43 edited according to the user-defined scenario is then sent to the recorder 1200. The recorder 1200 processes the edited multimedia stream data St43 to the data stream St45 format of the recording medium M, and thus records the formatted data stream St45 to the recording medium M. Note that the multimedia bitstream MBS recorded to the recording medium M contains the volume file structure VFS, which includes the physical address of the data on the recording medium generated by the video zone formatter 1300.

[0054] Note that the encoded multimedia bitstream MBS St35 may be output directly to the decoder to immediately reproduce the edited title content. It will be obvious that the output multimedia bitstream MBS will not in this case contain the volume file structure VFS.

Authoring decoder DC

[0055] A preferred embodiment of the authoring decoder DC used to decode the multimedia bitstream MBS edited by the authoring encoder EC of the present invention, and thereby reproduce the content of each title unit according to the user-defined scenario, is described next below with reference to Fig. 3. Note that in the preferred embodiment described below the multimedia bitstream St45 encoded by the authoring encoder EC is recorded to the recording medium M.

[0056] As shown in Fig. 3, the authoring decoder DC comprises a multimedia bitstream producer 2000, scenario selector 2100, decoding system controller 2300, stream buffer 2400, system decoder 2500, video buffer 2600, sub-picture buffer 2700, audio buffer 2800, synchronizer 2900, video decoder 3800, sub-picture decoder 3100, audio decoder 3200, synthesizer 3500, video data output terminal 3600, and audio data output terminal 3700.

[0057] The bitstream producer 2000 comprises a recording media drive unit 2004 for driving the recording medium M; a reading head 2006 for reading the information recorded to the recording medium M and producing the binary read signal St57; a signal processor 2008 for variously processing the read signal St57 to generate the reproduced bitstream St61; and a reproduction controller 2002.

[0058] The reproduction controller 2002 is connected to the decoding system controller 2300 from which the

multimedia bitstream reproduction control signal St53 is supplied, and in turn generates the reproduction control signals St55 and St59 respectively controlling the recording media drive unit (motor) 2004 and signal processor 2008.

[0059] So that the user-defined video, sub-picture, and audio portions of the multimedia title edited by the authoring encoder EC are reproduced, the authoring decoder DC comprises a scenario selector 2100 for selecting and reproducing the corresponding scenes (titles). The scenario selector 2100 then outputs the selected titles as scenario data to the authoring decoder DC.

[0060] The scenario selector 2100 preferably comprises a keyboard, CPU, and monitor. Using the keyboard, the user then inputs the desired scenario based on the content of the scenario input by the authoring encoder EC. Based on the keyboard input, the CPU generates the scenario selection data St51 specifying the selected scenario. The scenario selector 2100 is connected by an infrared communications device, for example, to the decoding system controller 2300, to which it inputs the scenario selection data St51.

[0061] Based on the scenario selection data St51, the decoding system controller 2300 then generates the bitstream reproduction control signal St53 controlling the operation of the bitstream producer 2000.

[0062] The stream buffer 2400 has a specific buffer capacity used to temporarily store the reproduced bitstream St61 input from the bitstream producer 2000, extract the address information and initial synchronization data SCR (system clock reference) for each stream, and generate bitstream control data St63. The stream buffer 2400 is also connected to the decoding system controller 2300, to which it supplies the generated bitstream control data St63.

[0063] The synchronizer 2900 is connected to the decoding system controller 2300 from which it receives the system clock reference SCR contained in the synchronization control data St81 to set the internal system clock STC and supply the reset system clock St79 to the decoding system controller 2300.

[0064] Based on this system clock St79, the decoding system controller 2300 also generates the stream read signal St65 at a specific interval and outputs the read signal St65 to the stream buffer 2400.

[0065] Based on the supplied read signal St65, the stream buffer 2400 outputs the reproduced bitstream St61 at a specific interval to the system decoder 2500 as bitstream St67.

[0066] Based on the scenario selection data St51, the decoding system controller 2300 generates the decoding signal St69 defining the stream Ids for the video, sub-picture, and audio bitstreams corresponding to the selected scenario, and outputs to the system decoder 2500.

[0067] Based on the instructions contained in the decoding signal St69, the system decoder 2500 respectively outputs the video, sub-picture, and audio bitstreams input from the stream buffer 2400 to the video buffer 2600, sub-picture buffer 2700, and audio buffer 2800 as the encoded video stream St71, encoded sub-picture stream St73, and encoded audio stream St75.

[0068] The system decoder 2500 detects the presentation time stamp PTS and decoding time stamp DTS of the smallest control unit in each bitstream St67 to generate the time information signal St77. This time information signal St77 is supplied to the synchronizer 2900 through the decoding system controller 2300 as the synchronization control data St81.

[0069] Based on this synchronization control data St81, the synchronizer 2900 determines the decoding start timing whereby each of the bitstreams will be arranged in the correct sequence after decoding, and then generates and inputs the video stream decoding start signal St89 to the video decoder 3800 based on this decoding timing. The synchronizer 2900 also generates and supplies the sub-picture decoding start signal St91 and audio stream decoding start signal St93 to the sub-picture decoder 3100 and audio decoder 3200, respectively.

[0070] The video decoder 3800 generates the video output request signal St84 based on the video stream decoding start signal St89, and outputs to the video buffer 2600. In response to the video output request signal St84, the video buffer 2600 outputs the video stream St83 to the video decoder 3800. The video decoder 3800 thus detects the presentation time information contained in the video stream St83, and disables the video output request signal St84 when the length of the received video stream St83 is equivalent to the specified presentation time. A video stream equal in length to the specified presentation time is thus decoded by the video decoder 3800, which outputs the reproduced video signal St104 to the synthesizer 3500.

[0071] The sub-picture decoder 3100 similarly generates the sub-picture output request signal St86 based on the sub-picture decoding start signal St91, and outputs to the sub-picture buffer 2700. In response to the sub-picture output request signal St86, the sub-picture buffer 2700 outputs the sub-picture stream St85 to the sub-picture decoder 3100. Based on the presentation time information contained in the sub-picture stream St85, the sub-picture decoder 3100 decodes a length of the sub-picture stream St85 corresponding to the specified presentation time to reproduce and supply to the synthesizer 3500 the sub-picture signal St99.

[0072] The synthesizer 3500 superimposes the video signal St104 and sub-picture signal St99 to generate and output the multi-picture video signal St105 to the video data output terminal 3600.

[0073] The audio decoder 3200 generates and supplies to the audio buffer 2800 the audio output request signal St88 based on the audio stream decoding start signal St93. The audio buffer 2800 thus outputs the audio stream St87 to the audio decoder 3200. The audio decoder 3200 decodes a length of the audio stream